

We claim as our invention:

- 1 1. A hydrogen gas generating system, comprising:  
2 a membrane electrode assembly including an anode, a cathode and an ionically  
3 conductive membrane therebetween;  
4 electrical connections for applying electrical power from a source of electrical power  
5 to said cathode and anode; and  
6 a non-circulating fuel transport system for transferring a water/fuel mixture by  
7 capillary action to said anode to generate hydrogen gas.
- 1 2. The invention of claim 1, wherein said non-circulating fuel transport system further  
2 comprises:  
3 a first portion in contact with the water/fuel mixture for transporting the water/fuel  
4 mixture to the anode and a second portion in contact with said first portion for collecting  
5 gases therefrom.
- 1 3. The invention of claim 2, wherein said first and second portions are interspersed.
- 1 4. The invention of claim 2, wherein said first and second portions are interlaced.
- 1 5. The inventions of claims 2 or 3, wherein  
2 said first portion is hydrophilic; and  
3 said second portion is hydrophobic.
- 1 6. The inventions of claims 2 or 3, wherein  
2 said first portion has higher capillary forces than said second portion.
- 1 7. The inventions of claims 2 or 3, wherein  
2 said first portion has a smaller effective pore size than said second portion.

1 8. The invention of claims 2 or 3 wherein the non-circulating fuel transport system  
2 further comprises:  
3 a replaceable fuel water canister.

1 9. A hydrogen gas generating system, comprising:  
2 a membrane electrode assembly including an anode, a cathode and an ionically  
3 conductive membrane therebetween;  
4 a fuel transport system for transferring a water/fuel mixture to said anode; and  
5 electrical connections for applying electrical power, from a source of electrical  
6 power generated by hydrogen gas, to said membrane electrode assembly to produce  
7 hydrogen gas,  
8 wherein excess hydrogen gas is produced by said membrane electrode assembly  
9 beyond the hydrogen gas directly consumed by said source of electrical power to provide  
10 power to said membrane electrode assembly.

1 10. The invention of claim 9, further comprising:  
2 a fuel cell.

1 11. The invention of claim 10, wherein the electrical connections further comprise:  
2 a series electrical connection between the membrane electrode assembly and the fuel  
3 cell.

1 12. The invention of claims 1 or 9, further comprising:  
2 a hydrogen gas storage tank associated with said anode for selectively storing the  
3 hydrogen gas provided by said membrane electrode assembly and for selectively releasing  
4 the hydrogen gas to the source of electrical power.

1 13. The inventions of claim 12, wherein a portion of the stored hydrogen gas is provided  
2 to the source of electrical power during startup operations of the source.

1 14. The inventions of claim 10, wherein the cumulative cell-amps of the H<sub>2</sub> generator are  
2 greater than the cumulative cell-amps of the fuel cell.

1 15. The inventions of claim 12, wherein the source of electrical power provides electrical  
2 power to a load in addition to said membrane electrode assembly, said invention further  
3 comprising:

4 a forward regulator for varying the amount of hydrogen gas provided by the  
5 membrane electrode assembly to the source of electrical power to enhance load following  
6 characteristics of the source for changes in the amount of electrical power required by the  
7 load.

1 16. The invention of claim 15, wherein the forward regulator opens to provide hydrogen  
2 gas to the source of electrical power during startup of the source.

1 17. The invention of claim 15, wherein said forward regulator opens to provide  
2 additional hydrogen gas to the source of electrical power when the operating efficiency of  
3 the source is reduced.

1 18. The invention of claim 15, wherein  
2 the source of electrical power provides electrical power to a load in addition to said  
3 membrane electrode assembly; and  
4 said forward regulator varies the amount of hydrogen gas provided by the membrane  
5 electrode assembly to the source of electrical power to enhance load following  
6 characteristics of the source for changes in the amount of electrical power required by the  
7 load.

1 19. The inventions of claim 15, further comprising:  
2 electrical connections for applying electrical power, produced by the load during  
3 regeneration, to said membrane electrode assembly while closing said forward regulator to  
4 store excess hydrogen produced by said membrane electrode assembly in said hydrogen  
5 storage tank.

1 20. The invention of claim 15, further comprising:  
2 a backpressure regulator between said membrane electrode assembly and said  
3 hydrogen storage tank;  
4 a vent regulator for controlling the pressure of gases being vented by said anode; and  
5 a connection for referencing the pressure of said backpressure regulator to said vent  
6 regulator to maintain the pressure at said cathode above the pressure at said anode.

1 21. The invention of claims 1 or 12 further comprising:  
2 a cooling system within said membrane electrode assembly for recovering liquid  
3 from gases produced by said membrane electrode assembly.

1 22. The invention of claim 21, wherein the cooling system further comprises:  
2 at least one cooling port positioned adjacent an upper end of said membrane  
3 electrode assembly to condense gaseous water fuel mixture in the gases produced thereby.

1 23. The invention of claim 21, wherein gaseous water/fuel mixture condensed adjacent  
2 said cathode is returned to said cathode.

1 24. The invention of claim 21, further comprising:  
2 a hydrophilic transport mechanism for returning the condensed water/fuel mixture to  
3 said cathode.

1 25. The invention of claim 22, wherein gaseous water/fuel mixture condensed adjacent  
2 said anode is returned to said anode.

1 26. The invention of claim 25, wherein gaseous water/fuel mixture condensed adjacent  
2 said anode is returned to said anode by said water/fuel transport system.

1 27. The invention of claim 26, wherein said membrane electrode assembly and water/fuel  
2 transport system forming a first cell, the invention further comprising:  
3 one or more additional cells positioned adjacent said first cell to form a stack;

4           current collectors position between each cell and at the beginning and end of the  
5 stack; and  
6           additional cooling ports positioned in an upper end of one or more of said current  
7 collectors.

1   28.    The invention of claims 1 or 9 wherein the membrane electrode assembly further  
2 comprises:  
3           a spiral coil.

1   29.    The invention of claim 28, further comprising:  
2           a housing surrounding the spiral coil,  
3           a hydrogen outlet at one end of the housing; and  
4           a fuel water canister at the other end of the housing.

1   30.    The invention of claim 29 wherein said housing is generally cylindrical.

1   31.    The invention of claim 29 wherein said hydrogen outlet forms a first electrode.

1   32.    The invention of claim 31 wherein said fuel canister forms a second electrode.

1   33.    The invention of claim 29 wherein said fuel canister forms a second electrode.

1   34.    The invention of claim 31 further comprising:  
2           a hollow central core within the spiral coil for venting CO<sub>2</sub> formed within the spiral  
3 coil.

1   35.    The invention of claim 34 further comprising:  
2           a backpressure regulating valve system in said housing in communication with said  
3 hydrogen outlet and said hollow central core.

1   36.    The invention of claim 35 further comprising:

2           a CO<sub>2</sub> supply line between the spiral coil and the fuel canister to pressurize the  
3 water fuel mixture.

1   37.    The invention of claim 34 further comprising:

2           a CO<sub>2</sub> supply line between the spiral coil and the fuel canister to pressurize the  
3 water fuel mixture.

1   38.    The invention of claim 29 wherein said housing further comprises:

2           a hydrogen storage volume in communication with the spiral coil.